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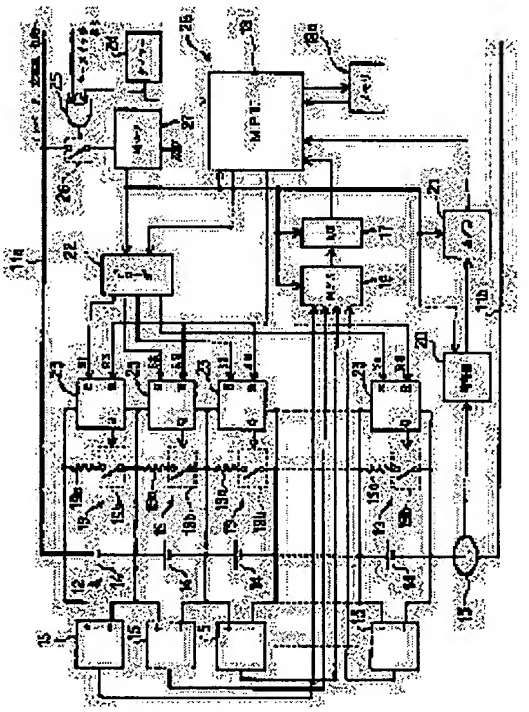
(54) METHOD AND DEVICE FOR ADJUSTING CHARGE STATE OF BATTERY PACK

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce costs, and to miniaturize a device for adjusting remaining capacity for each unit cell of a battery pack where a plurality of unit cells that can be charged and discharged are connected in series.
SOLUTION: When a timer 24 is actuated, an MPU 18 calculates the variance of the SOC of each unit cell. When a unit cell 14 where the variance of the SOC exceeds the tolerance of variance exists, the unit cell 14 is discharged. The cancellation of the variance of the SOC of each unit cell 14 is not limited a case when a battery pack 12 is charged. The unit cell 14 can be continuously discharged regardless of the charge of the battery pack 12, thus eliminating the need for increasing a discharge current when the unit cell 14 is discharged and hence eliminating the need for allowing a resistor 19a and a switch 19b in a unit cell discharge circuit 19 for discharging to cope with a large current, preventing the calorific value from being increased in the case of discharge, preventing cooling structure from being enlarged and added, and hence reducing costs and miniaturizing a device.



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The charge condition adjustment method of the group cell characterized by to always adjust the remaining capacity of each unit cell concerned according to an individual in the charge condition adjustment method of adjusting charge and the charge condition of a group cell discharge according to coming to connect with a serial two or more rechargeable batteries in which charge and discharge are possible as a unit cell, and a load and a battery charger being connected to the both ends so that dispersion in the remaining capacity of each of said unit cell may become in predetermined tolerance.
[Claim 2] In a charge condition adjusting device which adjusts charge and a discharging charge condition of a group cell according to coming to connect with a serial two or more rechargeable batteries in which charge and discharge are possible as a unit cell, and a load and a battery charger being connected to the both ends A charge condition adjusting device of a group cell characterized by having a remaining capacity adjustment means to always adjust remaining capacity of each unit cell concerned according to an individual so that dispersion in remaining capacity of each of said unit cell may become in predetermined tolerance.
[Claim 3] A starting means which said remaining capacity adjustment means starts with time of day set up beforehand or a time interval, A remaining capacity detection means for it to be started by this starting means and to detect remaining capacity of each of said unit cell, A dispersion count means to calculate dispersion in remaining capacity of each unit cell based on remaining capacity of each unit cell which was started by said starting means and detected by said remaining capacity detection means, A dispersion judging means to judge whether dispersion in remaining capacity of each unit cell which was started by said starting means and calculated by said dispersion count means has crossed the inside of said predetermined tolerance, A discharge command means to order discharge a unit cell judged as it having been started by said starting means and dispersion in remaining capacity having crossed the inside of said predetermined tolerance with said dispersion judging means, Have a discharge means to discharge said each unit cell according to an individual, and a discharge control means which it is based [control means] on a command of said discharge command means, and starts and stops discharge of a unit cell with said discharge means, and it is constituted. When what said starting means started said discharge control means for is embraced, discharge of a unit cell is started and stopped with said discharge means and discharge of a unit cell is made to start A charge condition adjusting device of a group cell according to claim 2 characterized by setting by the time said starting means starts next, and making discharge of this unit cell continue.
[Claim 4] Said discharge control means is the charge condition adjusting device of a group cell according to claim 3 characterized by supplying electric power from a unit cell which is the discharge controlled system of the discharge control means concerned.
[Claim 5] Said discharge control means is the charge condition adjusting device of a group cell according to claim 4 characterized by electric supply from the unit cell concerned being stopped by a discharge halt and coincidence of the unit cell concerned while electric supply from the unit cell concerned is started by discharge starting and coincidence of a unit cell which are the discharge controlled system of the discharge control means concerned.
[Claim 6] Said discharge control means is the charge condition adjusting device of a group cell according to claim 3 to 5 characterized by consisting of flip-flop circuits.
[Claim 7] Said unit cell is the charge condition adjusting device of a group cell according to claim 2 to 6 characterized by being a lithium system rechargeable battery.
[Claim 8] Said group cell is the charge condition adjusting device of a group cell according to claim 2 to 7 characterized by being used for a power unit as a power supply of an electric vehicle.
[Claim 9] Said group cell is the charge condition adjusting device of a group cell according to claim 2 to 7 characterized by being used for a power unit as a power supply of a hybrid electric vehicle.

[Claim 10] A charge condition adjusting device of a group cell according to claim 2 to 9 characterized by adjusting voltage of said group cell as said charge condition.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the charge condition adjustment method and charge condition adjusting device which adjust charge and the discharging charge condition of a group cell according to coming to connect with a serial two or more rechargeable batteries in which charge and discharge are possible as a unit cell, and a load and a battery charger being connected to the both ends.
[0002]
[Description of the Prior Art] In recent years, the electric vehicle without the problem of the air pollution by exhaust gas etc. and the hybrid electric vehicle compatible in low pollution and performance-traverse ability attract attention from the purpose of earth environmental protection. since especially the hybrid electric vehicle carries the engine, even if it does not prepare the cell as what is applied to an electric vehicle -- a gasoline-powered vehicle and abbreviation -- equivalent performance-traverse ability is securable, and moreover, since it drives with power at the time of low-speed transit, as compared with the gasoline-powered vehicle which discharges a lot of exhaust gas at the time of low-speed transit, it has the feature of being environment-friendly. It is thought that a hybrid electric vehicle is preceded and spreads rather than an electric vehicle from such a situation.
[0003] By the way, since it says that the weight of the whole vehicles becomes large by a hybrid electric vehicle's driving with power at the time of start and full acceleration, and carrying many components, such as an engine and a motor generator, as a cell applied to a hybrid electric vehicle, the lightweight thing is demanded highly efficiently like what is applied to an electric vehicle.
[0004] Under such a condition, the lithium cell attracts attention as what is replaced with a lead cell, a nickel cadmium cell, or a nickel hydoride battery. Since it has one about 4 times the high weight energy density of this compared with the lead cell of this capacity and has twice [about] as many high weight energy density as this compared with the nickel hydoride battery of this capacity, the lithium cell is expected as a suitable cell for a hybrid electric vehicle.
[0005] However, if this lithium cell is not used within the limits of the voltage specified since it was weak to a surcharge or overdischarge, a material decomposes, capacity decreases remarkably, and it carries out unusual pyrexia, and has a possibility of resulting in an unusable condition. Therefore, generally, maximum voltage and minimum voltage are specified clearly, it is used, carrying out armature-voltage control, or a lithium cell is used with the protection network which restricts a voltage range so that it may become specified within the limits of it.
[0006] By the way, since a motor is driven and high voltage is needed, two or more cells (unit cell) are connected to a serial, and the battery used for a hybrid electric vehicle or an electric vehicle is usually constituted as a group cell. namely, -- case the battery voltage of 300V is required -- per [2 / about] unit cell -- 150 unit cells connect with a serial by the lead cell of V -- having -- per [1.2 / about] unit cell -- 250 unit cells connect with a serial in the nickel hydoride battery of V -- having -- per [3.6 / about] unit cell -- 80 unit cells will be connected to a serial in the lithium cell of V. And when many unit cells charged and discharged the group cell which it comes to connect with a serial in this way, charge and discharge were controlled by the former by supervising the voltage between terminals between the positive electrode of a group cell, and a negative electrode.
[0007] Here, dispersion in the voltage between terminals (cel voltage) of the unit cell resulting from the remaining capacity (it is hereafter called SOC (State Of Charge) for short) of each unit cell poses a problem in this case. That is, where a unit cell is connected to a serial, although the current which flows each unit cell is an equal, since dispersion is in SOC of each unit cell by the difference in the amount of the self-discharge for every unit cell, or charge-and-discharge effectiveness, change of the voltage between terminals of each unit cell becomes a different thing. And it is accumulated and dispersion in this SOC is expanded as time amount passes.

[0008] Even if a unit cell supervises the voltage between terminals of the group cell which it comes to connect with a serial and controls charge and discharge by such the bottom, therefore, as each unit cell Since that to which the voltage between terminals is higher than the average voltage obtained as (voltage between terminals of group cell)/(unit-cell number) exists, and what is lower than average voltage exists, If a unit cell with the voltage between terminals higher than average voltage is charged to maximum voltage, the unit cell will serve as a surcharge, and if the voltage between terminals discharges a unit cell lower than average voltage to minimum voltage, the unit cell will serve as overdischarge.
[0009] In this case, even if the lead cell and nickel cadmium cell which were mentioned above, and a nickel hydoride battery serve as a surcharge and overdischarge, there is no possibility of resulting in a condition with the engine performance unusable only by deteriorating somewhat, but as mentioned above, when a lithium cell becomes a surcharge and overdischarge, it has a possibility of resulting in an unusable condition.
[0010] There is a method currently indicated by JP,2-136445,U to solve such fault. This method controls discharge to end discharge, when controlling charge, and discharging and the voltage between terminals of the unit cell which has the minimum voltage reaches minimum voltage so that the voltage between terminals of the unit cell which has a maximum voltage may not exceed maximum voltage, in case a maximum voltage and the minimum voltage are detected and it charges from from among the voltage between terminals of each unit cell.
[0011] However, although it can prevent beforehand becoming a surcharge and overdischarge by this method by charging and discharging all unit cells within the limits of predetermined voltage in this way Since discharge will be restricted to the unit cell which charge is restricted to the unit cell which has a maximum voltage, and has the minimum voltage, when dispersion in SOC is large, there is a problem that the capacity as the part and a group cell becomes small.

[0012]
[Problem(s) to be Solved by the Invention] Then, there is a method currently indicated by JP,8-19188,A to solve such fault. Hereafter, the method currently indicated by this JP,8-19188,A is explained with reference to drawing 10 .
[0013] In drawing 10 , as for the group cell 1, many unit cells 2 are connected and constituted by the serial, and the unit-cell discharge circuit (bypass circuit) 3 where it comes to connect resistance 3a and switch 3b with a serial is connected to each [these] unit cell 2 at juxtaposition. Each voltage detector 4 between terminals detects the voltage between terminals of each unit cell 2, and outputs the unit-cell voltage signal which shows the voltage between the terminal to a control unit 5. Moreover, a charge circuit 6 generates desired charge power by changing commercial alternating current power into direct current power.
[0014] In order to start charge, when a switch 7 is turned on according to such a configuration (closing), a control unit 5 turns on a switch 8 (closing). Thereby, direct current power (charge power) is supplied to the group cell 1 from a charge circuit 6, and the group cell 1 comes to be charged.
[0015] Subsequently, a control unit 5 detects the voltage between terminals of each unit cell 2 by inputting a unit-cell voltage signal from each voltage detector 4 between terminals, and when the unit cell 2 to which the voltage between terminals is over the predetermined value among many unit cells 2 exists, it turns on switch 3b of the unit-cell discharge circuit 3 corresponding to the unit cell 2 (closing). The unit cell 2 to which the voltage between terminals is over the predetermined value comes to start discharge by this, and dispersion in the voltage between terminals of a unit cell 2, i.e., dispersion of SOC, comes to be canceled as a result.
[0016] However, by this method, the opportunity for dispersion in such SOC to be canceled is restricted to the time when the group cell 1 is charged, when direct current power is supplied to the group cell 1 from the charge circuit 6 that is,. Therefore, like a hybrid electric vehicle, in case a unit cell 2 is discharged, it is necessary to enlarge especially, the energization current per time (discharge current) to which the resistance welding time of the unit-cell discharge circuit 3 will not be short with a configuration which repeats charge and discharge gradually and performs it. When it becomes so, it is necessary to make into the thing corresponding to a high current resistance 3a and switch 3b which constitute the unit-cell discharge circuit 3, and there is a problem that originate in this, and cost will increase or a circuit will large-sized-ize.
[0017] Moreover, since the unit-cell discharge circuit 3 makes energy consume by pyrexia of resistance 3a and calorific value will become large in proportion to the square of energization current if energization current is enlarged in this way, calorific value will increase. When it becomes so, it is necessary to large-sized-ize cooling structures, such as the part, a radiation fin, and a cooling fan, or to add another components for cooling, and there is also a problem that cost will increase even if it originates in this, or the whole equipment will large-sized-ize.
[0018] This invention is made in view of the above-mentioned situation. The purpose In what adjusts charge and the discharging charge condition of a group cell according to coming to connect with a serial two or more rechargeable

batteries in which charge and discharge are possible as a unit cell, and a load and a battery charger being connected to the both ends It is in offering the charge condition adjustment method and charge condition adjusting device of a group cell which can attain the miniaturization of reduction of cost, and the whole equipment.
[0019]
[Means for Solving the Problem] According to a charge condition adjustment method of a group cell according to claim 1, remaining capacity of each unit cell which constitutes a group cell is always adjusted according to an individual so that dispersion in remaining capacity of each [these] unit cell may become in predetermined tolerance. That is, since an opportunity for dispersion in remaining capacity of each unit cell to be canceled becomes possible [it not being restricted to the time when a group cell is charged unlike the conventional thing, and always discharging a unit cell], in case it discharges a unit cell, it does not have to enlarge the discharge current.
[0020] Therefore, since it is not necessary to large-sized-ize cooling structure or to add electronic parts, such as resistance for discharging a unit cell, without not corresponding to a high current and calorific value increasing on the occasion of discharge, a miniaturization of reduction of cost and the whole equipment can be attained.
[0021] According to the charge condition adjusting device of a group cell according to claim 2, a remaining capacity adjustment means always adjusts remaining capacity of each unit cell concerned according to an individual so that dispersion in remaining capacity of each unit cell which constitutes a group cell may become in predetermined tolerance. That is, since an opportunity for dispersion in remaining capacity of each unit cell to be canceled becomes possible [it not being restricted to the time when a group cell is charged unlike the conventional thing, and always discharging a unit cell], in case it discharges a unit cell, it does not have to enlarge the discharge current.
[0022] Therefore, since it is not necessary to large-sized-ize cooling structure or to add electronic parts, such as resistance for discharging a unit cell, without not corresponding to a high current and calorific value increasing on the occasion of discharge, a miniaturization of reduction of cost and the whole equipment can be attained.
[0023] If a starting means starts according to the charge condition adjusting device of a group cell according to claim 3, as for a remaining capacity detection means, remaining capacity of each unit cell will be detected, and a dispersion count means will calculate dispersion in remaining capacity of each unit cell based on remaining capacity of each unit cell detected by remaining capacity detection means. Subsequently, a dispersion judging means judges whether dispersion in remaining capacity of each unit cell calculated by dispersion count means has crossed the inside of predetermined tolerance, and a discharge command means orders discharge a unit cell judged as dispersion in remaining capacity having crossed the inside of predetermined tolerance with a dispersion judging means. And when it is based on a command of a discharge command means, discharge of a unit cell is started and stopped with a discharge means and discharge of a unit cell is made to start, a discharge control means will be set by the time a starting means starts it next, and makes discharge of this unit cell continue.
[0024] When a starting means starts with time of day and a time interval which were set up beforehand, namely, by these remaining capacity detection means, a dispersion count means, dispersion judging means, discharge command means, discharge means, and discharge control means When discharge of a unit cell is started and suspended and discharge of a unit cell is started Even if it is after a starting means suspended starting since it will set by the time a starting means starts next, and discharge of this unit cell comes to be continued, discharge of a unit cell can be continued and the same operation effect as a thing according to claim 2 mentioned above can be acquired.
[0025] Since according to the charge condition adjusting device of a group cell according to claim 4 it constituted so that electric power might be supplied from a unit cell whose discharge control means is the discharge controlled system of the discharge control means concerned, a discharge control means Irrespective of an electric supply condition of other means, such as a remaining capacity detection means, a dispersion count means, a dispersion judging means, and a discharge command means Even if it is the case where could continue actuation, namely, electric power was no longer supplied to a means besides them, and actuation stops, when discharge of a unit cell is started, discharge of the condition, i.e., a unit cell, can be made to continue.
[0026] While electric supply from the unit cell concerned is started by discharge starting and coincidence of a unit cell whose discharge control means is the discharge controlled system of the discharge control means concerned according to the charge condition adjusting device of a group cell according to claim 5 Since it constituted so that electric supply from the unit cell concerned might be stopped by a discharge halt and coincidence of the unit cell concerned Though a discharge control means is the configuration that electric power is supplied from a unit cell which is the discharge controlled system of the discharge control means concerned, while a unit cell is not discharging, it can prevent that can prevent that electric power is supplied to a discharge control means, that is, remaining capacity of a unit cell falls.
[0027] According to the charge condition adjusting device of a group cell according to claim 6, since a flip-flop circuit constituted a discharge control means, a high circuit of versatility can constitute easily.

[0028] Since a lithium system rechargeable battery constituted a unit cell, after according to the charge condition adjusting device of a group cell according to claim 7 being able to prevent beforehand that a lithium system rechargeable battery served as a surcharge and overdischarge, that is, controlling charge and discharge of a lithium system rechargeable battery safely, engine performance of a lithium system rechargeable battery can fully be pulled out, and it can utilize.
[0029] Since according to the charge condition adjusting device of a group cell according to claim 8 it constituted so that a group cell might be used for a power unit as a power supply of an electric vehicle, engine performance and a battery life of a power unit in an electric vehicle can fully be raised.
[0030] Since according to the charge condition adjusting device of a group cell according to claim 9 it constituted so that a group cell might be used for a power unit as a power supply of a hybrid electric vehicle, engine performance and a battery life of a power unit in a hybrid electric vehicle can fully be raised.
[0031] According to the charge condition adjusting device of a group cell according to claim 10, voltage of a group cell can be adjusted exactly.
[0032]
[Embodiment of the Invention] (Gestalt of the 1st operation) The 1st example which applied this invention to that in which it is carried in a hybrid electric vehicle hereafter is explained with reference to drawing 1 thru/or drawing 5 . First, drawing 1 makes the electric configuration in this invention functional block, and shows it. Between positive side bus-bar 11a and negative side bus-bar 11b, the series circuit which consists of a group cell 12 which constitutes the battery as a power unit, and a current sensor 13 is connected. Two or more unit cells 14 which consist of a lithium system rechargeable battery are connected and constituted by the serial, and what builds in occlusion and the electrode to emit for the lithium ion is used for the group cell 12 as a lithium system rechargeable battery, for example.
[0033] The voltage detector 15 between terminals is connected to each unit cell 14 of the group cell 12 at juxtaposition. Each [these] voltage detector 15 between terminals detects the voltage between terminals of each unit cell 14, and outputs the unit-cell voltage signal which shows the voltage between the terminal to a multiplexer 16.
[0034] These unit-cells voltage signal will be chosen and a multiplexer 16 will output the selected unit-cell voltage signal to A/D converter 17, if a unit-cell voltage signal is given from each voltage detector 15 between terminals. If a unit-cell voltage signal is given from a multiplexer 16, A/D converter 17 will change the unit-cell voltage signal into a digital signal from an analog signal, and will output it to a microprocessor (a remaining capacity detection means as used in the field of this invention to call it MPU for short hereafter, a dispersion count means, a dispersion judging means, and discharge command means) 18.
[0035] Moreover, the unit-cell discharge circuit (a bypass circuit, discharge means as used in the field of this invention) 19 which consists of series circuits which become each unit cell 14 from resistance 19a and switch 19b is connected to juxtaposition.
[0036] The above-mentioned current sensor 13 detects the charge and discharge current (principal current) of the group cell 12, and outputs the charge and discharge current signal which shows the charge and discharge current to amplifier 20. If a charge and discharge current signal is given from a current sensor 13, amplifier 20 will amplify the charge and discharge current signal, and will output it to A/D converter 21. If the charge and discharge current signal amplified from amplifier 20 is given, A/D converter 21 will change the charge and discharge current signal into a digital signal from an analog signal, and will output it to MPU18.
[0037] Carrying out a deer, MPU18 calculates the remaining capacity (it is hereafter called SOC (State Of Charge) for short) of each unit cell 14 based on the unit-cell voltage signal given through a multiplexer 16 and A/D converter 17 from each voltage detector 15 between terminals, and the charge and discharge current signal given through amplifier 20 and A/D converter 21 from a current sensor 13. In this case, there is the method of calculating combining the method of calculating open-circuit voltage (it being hereafter called OCV (Open Circuit Voltage) for short) and the voltage between terminals to predetermined current as the count method of SOC based on the current potential property of a unit cell, and calculating from correlation with SOC memorized beforehand, the method of presuming from the addition value of a charge and discharge current or power, the methods of presuming from change of internal resistance, and these methods etc.
[0038] A decoder 22 is the set signal S1 - Sn based on the command from MPU18 to the flip-flop circuit 23 specified as each above-mentioned unit-cell discharge circuit 19 among the flip-flop circuits (discharge control means as used in the field of this invention) 23 connected to juxtaposition. It outputs. Each flip-flop circuit 23 is a decoder 22 to the set signal S1 - Sn. By making high-level the output signal which will be outputted to corresponding switch 19b of the unit-cell discharge circuit 19 if given, when the output signal with which switch 19b of each unit-cell discharge circuit 19 is given from each flip-flop circuit 23 becomes high-level, it turns on (closing).

[0039] A deer is carried out and they are the set signal S1 - Sn from a decoder 22 to a flip-flop circuit 23. If outputted, the unit cell 14 which the discharge current flows in the unit-cell discharge circuit 19 connected to juxtaposition in the flip-flop circuit 23, that is, is connected to juxtaposition in the flip-flop circuit 23 will start discharge.
[0040] Moreover, by making into a low level the output signal which will be outputted to corresponding switch 19b of the unit-cell discharge circuit 19 if reset-signal RS is given from the above MPU 18, the output signal with which switch 19b of each unit-cell discharge circuit 19 is given from each flip-flop circuit 23 turns off each flip-flop circuit 23, when set to a low level (Kaisei).
[0041] If a deer is carried out and reset-signal RS is outputted to a flip-flop circuit 23 from MPU18, when the discharge current is flowing in the unit-cell discharge circuit 19 connected to juxtaposition in the flip-flop circuit 23, the unit cell 14 which the discharge current will not flow, that is, is connected to juxtaposition in the flip-flop circuit 23 suspends discharge.
[0042] A timer (starting means as used in the field of this invention) 24 outputs a seizing signal to OR element 25 while outputting a seizing signal to MPU18 by predetermined timing (it is 1 time in 12 hours). OR element 25 will output an ON signal to a switch 26, if a seizing signal is given according to actuation of a key switch and a seizing signal is given from either, while a seizing signal is given from a timer 24. A switch 26 is turned on when an ON signal is given from OR element 25 (closing).
[0043] If a switch 26 turns on a regulator 27 (closing), it will supply electric power to the above-mentioned multiplexer 16, A/D converter 17, MPU18, amplifier 20, A/D converter 21, and a decoder 22 in predetermined voltage.
[0044] A deer is carried out, in the above-mentioned configuration, when an ON signal is outputted to a switch 26 from OR element 25 (i.e., when a seizing signal is outputted to OR element 25 from a timer 24), or when a seizing signal is given to OR element 25 according to actuation of a key switch, electric power is supplied to a multiplexer 16, A/D converter 17, MPU18, amplifier 20, A/D converter 21, and a decoder 22 from a regulator 27, and they operate. On the other hand, each above-mentioned flip-flop circuit 23 operates irrespective of whether electric power was supplied from each unit cell 14, that is, the timer 24 has started.
[0045] Moreover, memory 18a which consisted of RAM used as the execution area and working area of a control program is connected to the above MPU 18. In addition, the remaining capacity adjustment means 28 as used in the field of this invention consists of MPU18 explained above, a unit-cell discharge circuit 19, a flip-flop circuit 23, and a timer 24.
[0046] Subsequently, the concrete configuration of the above-mentioned unit-cell discharge circuit 19 and a flip-flop circuit 23 is explained with reference to drawing 2 . Switch 19b of the unit-cell discharge circuit 19 consists of PNP mold transistors 29, the NPN mold transistors 30-32, resistance 33-43, capacitors 44 and 45, and diode 46 are connected like illustration, and the flip-flop circuit 23 is constituted.
[0047] By such configuration, they are the set signal S1 - Sn to the flip-flop circuit 23 from a decoder 22. Since base current will flow through resistance 35 to the NPN mold transistor 30 when given, the NPN mold transistor 30 carries out a turn-on. Since the base current of the PNP mold transistor 29 will flow as collector current of the NPN mold transistor 30 through resistance 34 when the NPN mold transistor 30 carries out a turn-on, the PNP mold transistor 29 carries out a turn-on.
[0048] And when the PNP mold transistor 29 carries out a turn-on, the discharge current will flow to resistance 19a, and a unit cell 14 will start discharge by this. Moreover, since electromotive force will occur among the both-ends children of resistance 19a and base current will flow through resistance 38 and 39 to the NPN mold transistor 32 at this time, the NPN mold transistor 32 carries out a turn-on. If the NPN mold transistor 32 carries out a turn-on, the base current of the PNP mold transistor 29 will flow also as collector current of the NPN mold transistor 32 through resistance 37.
[0049] That is, when a unit cell 14 starts discharge, the base current of the PNP mold transistor 29 will flow as collector current of the NPN mold transistor 32 through resistance 37, while flowing as collector current of the NPN mold transistor 30 through resistance 34. Therefore, they are the set signal S1 - Sn temporarily at this time. Since the NPN mold transistor 32 does not carry out a turn-off even if it will not be given and the NPN mold transistor 30 carries out a turn-off, the turn-off of the PNP mold transistor 29 will not be carried out, a turn-on will be continued, and a unit cell 14 will continue discharge by this.
[0050] Since base current will flow through resistance 42 on the other hand to the NPN mold transistor 31 when reset-signal RS is given to a flip-flop circuit 23 from MPU18, the NPN mold transistor 31 carries out a turn-on. If the NPN mold transistor 31 carries out a turn-on, since the collector current of the NPN mold transistor 31 will flow and base current will not flow to the NPN mold transistor 32, the NPN mold transistor 32 carries out a turn-off.
[0051] And if the NPN mold transistor 32 carries out a turn-off, since the path of the base current of the PNP mold transistor 29 will be lost and the base current of the PNP mold transistor 29 will not flow, the PNP mold transistor 29

will carry out a turn-off, the discharge current will not flow to resistance 19a, and a unit cell 14 will suspend discharge by this. Moreover, even if reset-signal RS will not be given and the NPN mold transistor 31 carries out a turn-off at this time, the turn-on of the PNP mold transistor 29 will not be carried out, it will continue a turn-off, and will continue a halt of discharge of a unit cell 14 by this.

[0052] namely, in this example, from the unit-cell discharge circuit 19 and the flip-flop circuit 23 being constituted as mentioned above The set signal S1 - Sn According to being given, the discharge current flows to resistance 19a of the unit-cell discharge circuit 19, a unit cell 14 comes to start discharge, and they are the condition to the set signal S1 - Sn. Even if not given A unit cell 14 does not suspend discharge and discharge is continued. And from the condition, according to reset-signal RS being given, the discharge current will not flow to resistance 19a of the unit-cell discharge circuit 19, and a unit cell 14 suspends discharge.

[0053] Moreover, since it is placed between any paths between touch-down by the NPN mold transistors 30-32 in a flip-flop circuit 23 in this case between a high potential side and low voltage sides and a these high potential and low voltage side, in the condition that these NPN mold transistors 30-32 are carrying out the turn-off, the leakage current is controlled and the leakage current as the flip-flop circuit 23 whole is also controlled.

[0054] Therefore, a unit cell 14 is the set signal S1 - Sn. The electric supply to a flip-flop circuit 23 will be stopped at the same time it suspends discharge according to the electric supply to a flip-flop circuit 23 being started, and reset-signal RS being given to a flip-flop circuit 23 at the same time it starts discharge according to a flip-flop circuit 23 being given.

[0055] Next, drawing 3 thru/or drawing 5 are also referred to and explained about an operation of the above-mentioned configuration. In addition, suppose that the portion 16 to which electric power is supplied from a regulator 27, i.e., a multiplexer, A/D converter 17, MPU18, amplifier 20, A/D converter 21, and a decoder 22 are called a control circuit after this, the condition that electric power is supplied to the control circuit from the regulator 27 is called "dispersion judging mode", and the condition that electric power is not supplied to the control circuit from a regulator 27 is called "dispersion cel discharge mode."

[0056] moreover, it is shown in drawing 3 among the unit cells 14 of a large number which constitute the group cell 12 -- as -- three unit-cell B1 -B3 representing -- each -- unit-cell B1 -B3 it charges to a respectively suitable capacity -- having -- **** -- each -- unit-cell B1 -B3 Voltage V1-V3 between terminals (cel voltage) an initial state shows to drawing 5 -- as -- V1 >V3 >V2 It shall have a relation. Furthermore, the seizing signal shall not be given to OR element 25 in the condition that have parked the hybrid electric vehicle, that is, the timer 24 has not started. In addition, drawing 4 shows the processing which MPU18 performs as a flow chart, and drawing 5 shows the portion relevant to it as a timing diagram.

[0057] Now, if a timer 24 starts, a seizing signal is outputted to OR element 25 from a timer 24, an ON signal is outputted to a switch 26 from OR element 25, a switch 26 turns on (closing) and electric power is supplied to a control circuit from a regulator 27, a control circuit will serve as "dispersion judging mode" (the inside of drawing 5 , and t1 reference).

[0058] When electric power is supplied to MPU18, it turns off switch 19b of the unit-cell discharge circuit 19 connected to each unit cell 14 at juxtaposition by outputting reset-signal RS to the flip-flop circuit 23 connected to each unit cell 14 at juxtaposition (step S1). (Kaisei) Since switch 19b turned on (closing) will turn off by this (Kaisei), if it is the unit cell 14 which was discharging among many unit cells 14 at that time, and this case, it is a unit cell B1 and B3. It sets and is the discharge current I1 and I3. It will not flow, that is, is a unit cell B1 and B3. Discharge will be suspended.

[0059] Subsequently, MPU18 carries out predetermined time standby (step S2). Here, predetermined time standby is carried out for avoiding the effect by fluctuation of the voltage between terminals resulting from transient phenomenon according to the unit cell 14 having suspended discharge. That is, the predetermined time in this case is time amount expected to be completed by fluctuation of the voltage between terminals of a unit cell 14. If MPU18 carries out predetermined time progress, it will be judged to be "YES" in step S3, and will calculate SOC of each unit cell 14 based on the unit-cell voltage signal given through a multiplexer 16 and A/D converter 17 from each voltage detector 15 between terminals, and the charge and discharge current signal given through amplifier 20 and A/D converter 21 from a current sensor 13 (the inside of step S4 and drawing 5 , and t2 reference).

[0060] Subsequently, MPU18 detects the minimum value from from among SOC of each unit cell 14, calculates a difference with the minimum SOC, i.e., dispersion of SOC, every unit cell 14 (step S5), and judges whether the unit cell 14 to which dispersion in SOC has crossed the inside of a predetermined fluctuation check limit exists (step S6).

[0061] At this time, it is VH about the maximum voltage of the voltage between terminals equivalent to a predetermined fluctuation check limit. If it carries out If it is this case, it is the unit cell B1 among many unit cells 14, and B3. The voltage V1 between terminals, and V3 Maximum voltage VH Have exceeded, that is, since dispersion in SOC has

crossed the inside of a predetermined fluctuation check limit MPU18 -- step S6 -- setting -- "YES" -- judging -- a decoder 22 to the unit cell B1, and B3 the flip-flop circuit 23 connected to juxtaposition -- respectively -- the set signal S1 and S3 By making it output A unit cell B1 and B3 Switch 19b of the unit-cell discharge circuit 19 connected to juxtaposition is turned on (step S7). (closing) Thereby, it is the discharge current I1 and I3. It flows, that is, is a unit cell B1 and B3. Discharge will be started.

[0062] Subsequently, if starting of a timer 24 stops, a seizing signal is no longer outputted to OR element 25 from a timer 24, an ON signal is no longer outputted to a switch 26 from OR element 25, a switch 26 turns off (Kaisei) and electric power is no longer supplied to a control circuit from a regulator 27, a control circuit will serve as "dispersion cel discharge mode" (the inside of drawing 5 , and t3 reference).

[0063] Now, at this time, electric power is no longer supplied to MPU18 and a decoder 22, and it is the set signal S1 and S3 from a decoder 22. The unit cell B1 which started discharge since it acted as the unit-cell discharge circuit 19 and the flip-flop circuit 23 mentioned above although outputted no longer, and B3 Discharge will not be suspended and discharge will be continued between "dispersion cel discharge modes."

[0064] Now, if MPU18 repeats and performs the same processing as this after this and a timer 24 starts next, steps S1-S7 will be performed again (the inside of drawing 5 , and t4 reference). In this case, MPU18 is the unit cell B3 among many unit cells 14. Voltage V3 between terminals Maximum voltage VH It detects having become the following. Unit cell B1 Voltage V1 between terminals Maximum voltage VH Since it detects having exceeded (the inside of drawing 5 , and t5 reference), it is a decoder 22 to the set signal S1. By making it output Unit cell B1 Only switch 19b of the unit-cell discharge circuit 19 connected to juxtaposition is turned on (closing). Thereby, it is the discharge current I1. It flows, that is, is a unit cell B1. Discharge will be started again.

[0065] Furthermore, MPU18 will perform steps S1-S7 again, if a timer 24 starts next (the inside of drawing 5 , and t7 reference). In this case, for MPU18, the voltage between terminals of all the unit cells 14 is the maximum voltage VH. Since it detects having become the following (the inside of drawing 5 , and t8 reference), they are a decoder 22 to the set signal S1 - Sn. It is not made to output, that is, neither of the unit cells 14 starts discharge.

[0066] Namely, in this thing, whenever a timer 24 starts MPU18 When the unit cell 14 to which dispersion in SOC of each unit cell 14 was calculated, and dispersion in SOC has crossed the inside of a predetermined fluctuation check limit exists A decoder 22 to the set signal S1 - Sn The corresponding unit cell 14 is made to discharge and, thereby, dispersion in SOC of each unit cell 14 is made to cancel until a timer 24 starts next by making it output.

[0067] In addition, although the above explains the case where the hybrid electric vehicle has parked a car, a hybrid electric vehicle will perform steps S1-S7 to which a timer 24 to the seizing signal mentioned MPU18 above by being given directly, when it is in a run state and the seizing signal is given to OR element 25 according to actuation of a key switch.

[0068] Thus, MPU18 calculates dispersion in SOC of each unit cell 14, and when the unit cell 14 to which dispersion in SOC has crossed the inside of a fluctuation check limit exists, it comes to make the unit cell 14 discharge, if a timer 24 starts according to the 1st example. That is, since the opportunity for dispersion in SOC of each unit cell 14 to be canceled becomes possible [it not being restricted to the time when the group cell 12 is charged unlike the conventional thing, and always discharging a unit cell 14 irrespective of charge of the group cell 12], in case it discharges a unit cell 14, it does not have to enlarge the discharge current. Therefore, since it is not necessary to large-sized-ize cooling structure or to add resistance 19a and switch 19b in the unit-cell discharge circuit 19 for discharging a unit cell 14, without not corresponding to a high current and calorific value increasing on the occasion of discharge, the miniaturization of reduction of cost and the whole equipment can be attained.

[0069] Moreover, a flip-flop circuit 23 can make discharge of the condition 14, i.e., a unit cell, continue, since it constituted so that electric power might be supplied to the flip-flop circuit 23 which controls discharge of a unit cell 14 from a unit cell 14, when discharge of a unit cell 14 is started, even if it is the case where could continue actuation, namely, electric power was no longer supplied to the control circuit, and actuation stops irrespective of the electric supply condition of a control circuit.

[0070] Moreover, the set signal S1 - Sn It embraces that a flip-flop circuit 23 is given. A unit cell 14 starts the electric supply to a flip-flop circuit 23 at the same time a unit cell 14 starts discharge. Moreover, since it constituted so that a unit cell 14 might stop the electric supply to a flip-flop circuit 23 while the unit cell 14 suspended discharge according to reset-signal RS being given to a flip-flop circuit 23 While the unit cell 14 is not discharging, it can prevent that can prevent that a unit cell 14 supplies electric power to a flip-flop circuit 23, that is, SOC of a unit cell 14 falls.

[0071] Moreover, as the circuit which controls discharge of a unit cell 14, i.e., a circuit which controls turning on and off (closing motion) of switch 19b in the unit-cell discharge circuit 19, since the flip-flop circuit 23 was adopted, it can constitute easily, and since the circuit was constituted from high electronic parts of the versatility of a transistor,

resistance, a capacitor, etc. moreover in this case, it is cheaply realizable.
[0072] Moreover, since the lithium system rechargeable battery constituted the unit cell 14, after being able to prevent beforehand that a lithium system rechargeable battery served as a surcharge and overdischarge, that is, controlling charge and discharge of a lithium system rechargeable battery safely, the engine performance of a lithium system rechargeable battery can fully be pulled out, and it can utilize.
[0073] Furthermore, since it constituted so that the group cell 12 might be used as a power unit (battery) of a hybrid electric vehicle, the engine performance and battery life of a power unit in a hybrid electric vehicle can fully be raised.
[0074] (Gestalt of the 2nd operation) Next, the 2nd example of this invention is explained with reference to drawing 6 thru/or drawing 9 . In addition, the same sign is given to the same portion as the 1st example mentioned above, explanation is omitted, and a different portion is explained hereafter. Unlike the 1st example mentioned above in this 2nd example, MPU18 to reset-signal RS is not given, but each flip-flop circuit 23 is reset-signal RS1 -RSn from a decoder 51. It is given according to an individual. That is, a decoder 51 is reset-signal RS1 -RSn based on the command from MPU18 to the flip-flop circuit 23 specified as each above-mentioned unit-cell discharge circuit 19 among the flip-flop circuits 23 connected to juxtaposition. It outputs and each flip-flop circuit 23 is reset-signal RS1 -RSn from a decoder 51. If given, the output signal outputted to corresponding switch 19b of the unit-cell discharge circuit 19 will be made into a low level.
[0075] Next, drawing 7 thru/or drawing 9 are also referred to and explained about an operation of the above-mentioned configuration. In this case, if a timer 24 starts and a control circuit serves as "dispersion judging mode" (the inside of drawing 9 , and t1 reference), MPU18 will calculate SOC of each unit cell 14 based on the unit-cell voltage signal given through a multiplexer 16 and A/D converter 17 from each voltage detector 15 between terminals, and the charge and discharge current signal given through amplifier 20 and A/D converter 21 from a current sensor 13 (the inside of step 11 and drawing 9 , and t2 reference).
[0076] Subsequently, MPU18 detects the minimum value from from among SOC of each unit cell 14, and judges whether ****** (step S12) and the unit cell 14 to which dispersion in SOC has crossed the inside of a predetermined fluctuation check limit exist in a difference with the minimum SOC, i.e., dispersion of SOC, every unit cell 14 (step S13).
[0077] If it is this case at this time, it is the unit cell B1 among many unit cells 14, and B3. The voltage V1 between terminals, and V3 Maximum voltage VH Have exceeded, that is, since dispersion in SOC has crossed the inside of a predetermined fluctuation check limit MPU18 -- step S13 -- setting -- "YES" -- judging -- a decoder 22 to the unit cell B1, and B3 the flip-flop circuit 23 connected to juxtaposition -- respectively -- the set signal S1 and S3 By making it output A unit cell B1 and B3 Switch 19b of the unit-cell discharge circuit 19 connected to juxtaposition is turned on (step S14). (closing) Thereby, it is the discharge current I1 and I3. It flows, that is, is a unit cell B1 and B3. Discharge will be started.
[0078] On the other hand, it is unit-cell B-2 among many unit cells 14. Voltage V2 between terminals Maximum voltage VH Have become the following, that is, since dispersion in SOC has become in the predetermined fluctuation check limit MPU18 is a decoder 51 to unit-cell B-2. It is reset-signal RS2 to the flip-flop circuit 23 connected to juxtaposition. By making it output Unit-cell B-2 Switch 19b of the unit-cell discharge circuit 19 connected to juxtaposition is turned off (step S15). (Kaisei) Thereby, it is the discharge current I2. It does not flow, that is, is unit-cell B-2. Discharge is not started.
[0079] Subsequently, if starting of a timer 24 stops and electric power is no longer supplied to a control circuit from a regulator 27, a control circuit will serve as "dispersion cel discharge mode" (the inside of drawing 9 , and t3 reference). Since electric power is no longer supplied to MPU18, a decoder 22, and a decoder 51 at this time, it is a decoder 22 to the set signal S1, and S3. It is no longer outputted and is reset-signal RS2 from a decoder 51. Although outputted no longer The unit cell B1 which started discharge like the 1st example mentioned above, and B3 Discharge will not be suspended and discharge will be continued.
[0080] Now, if MPU18 repeats and performs the same processing as this after this also in this case and a timer 24 starts next, steps S11-S16 will be performed again (the inside of drawing 9 , and t4 reference). In this case, MPU18 is the unit cell B3 among many unit cells 14. Voltage V3 between terminals Maximum voltage VH It detects having become the following. Unit cell B1 Voltage V1 between terminals Maximum voltage VH Since it detects having exceeded (the inside of drawing 9 , and t5 reference), it is a decoder 22 to the set signal S1. By making it output Unit cell B1 Only switch 19b of the unit-cell discharge circuit 19 connected to juxtaposition is turned on (closing), and they are reset-signal RS2 and RS3 from a decoder 51. By making it output Unit-cell B-2 and B3 Switch 19b of the unit-cell discharge circuit 19 connected to juxtaposition is turned off (Kaisei). Thereby, it is the discharge current I1. It flows continuously, that is, is a unit cell B1. Discharge will be continued and it is the discharge current I3. It will not flow, that is, is a unit

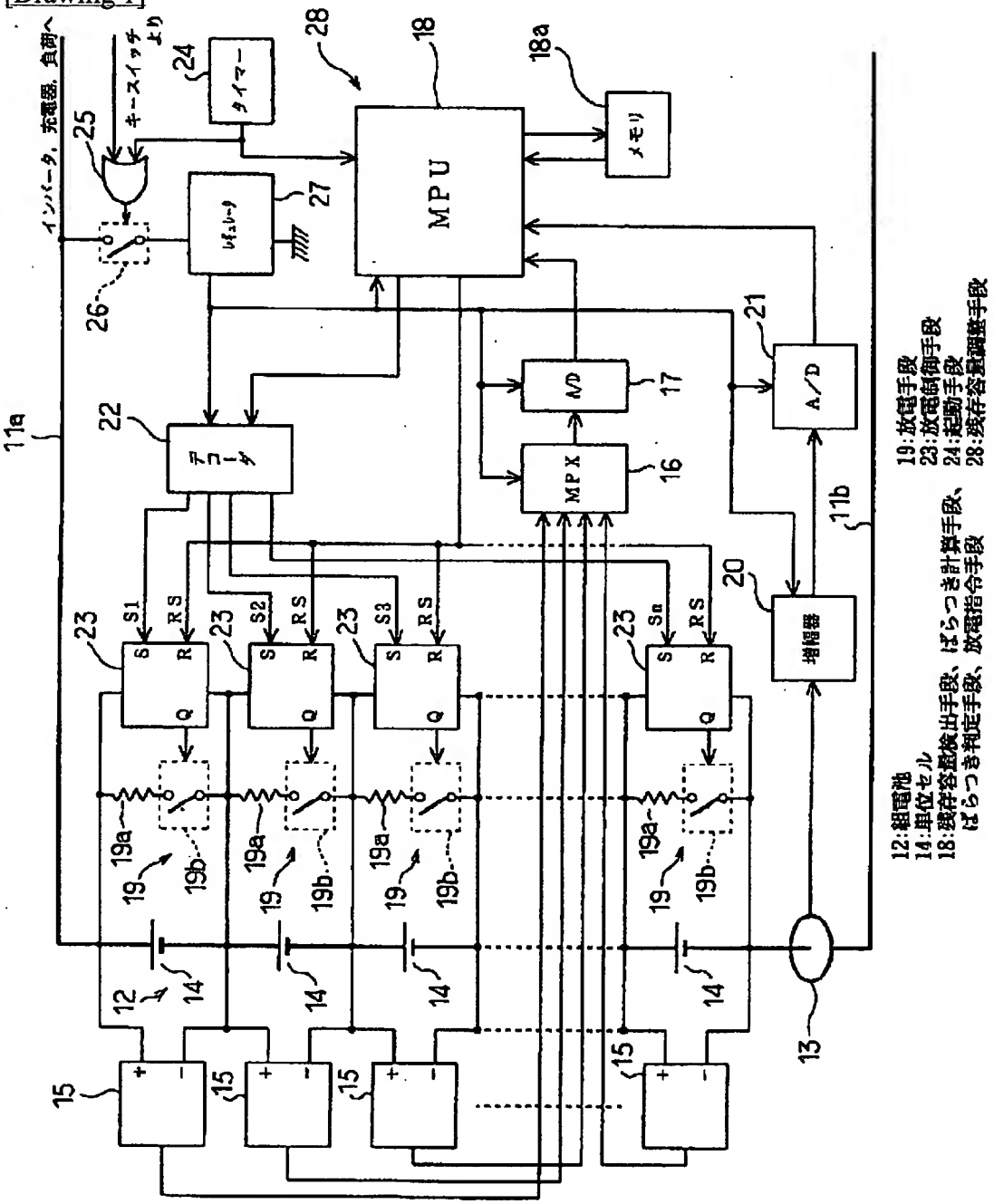
cell B3. Discharge will be suspended.
[0081] Furthermore, MPU18 will perform steps S11-S16 again, if a timer 24 starts next (the inside of drawing 9 , and t7 reference). In this case, MPU18 is since it detects that the voltage between terminals of all the unit cells 14 became a maximum voltage VH less or equal (among drawing 9). t8 In reference and step S13, it is judged as "NO", and they are the set signal S1 - Sn from a decoder 22. It is not made to output. A decoder 51 to reset-signal RS1 -RSn Switch 19b of (step S16) each unit-cell discharge circuit 19 is turned off by making it output (Kaisei). By this, all the unit cells 14 will suspend discharge.
[0082] Namely, the 1st examples mentioned above in this 2nd example differ, and are reset-signal RS1 -RSn from DEKOTA 31. By considering as the configuration outputted according to an individual It becomes possible to detect SOC in the condition that the unit cell 14 is discharging, and it becomes possible to omit the processing which suspends discharge of all the unit cells 14 in order to detect SOC, and the processing which carries out predetermined time standby in order to avoid the effect by fluctuation of the voltage between terminals. The control algorithm of what needs to add a decoder 51 by this as compared with the 1st example mentioned above can be simplified, and there is an advantage that a charging time value can be shortened.
[0083] By the way, although SOC cannot be detected correctly and there is fear since the voltage between terminals is changed by the voltage drop by the product of internal resistance and the discharge current when it is made the configuration which detects SOC in the condition that the unit cell 14 is discharging in this way By this invention, since the discharge current can be set to several mA - about dozens of mA by always discharging, SOC may be detected in the condition that the unit cell 14 is discharging in this way, from a voltage drop being small enough to the capacity of a unit cell 14.
[0084] Thus, according to the 2nd example, the same operation effect as the 1st example mentioned above can be acquired, and a control algorithm can be simplified especially in this case, and there is an advantage that a charging time value can be shortened.
[0085] (Gestalt of other operations) This invention is not limited only to the above-mentioned example, and can be transformed or extended as follows. Yes, you may apply to what is carried not only in a thing but in the electric vehicle carried in a Brit electric vehicle, and as long as it is the rechargeable battery equipment for stationary energy storage which uses the group cell which comes to connect many unit cells with a serial, you may apply.
[0086] As a unit cell, you may be not only a lithium system rechargeable battery but a lead cell and a nickel cadmium cell, a nickel hydoride battery, etc., and may be two or more cel groups and cel modules which come to connect a unit cell with a serial or juxtaposition. You may make it start a timer with a desired time interval in 12 hours not only according to starting once but according to system use conditions etc.
[0087] In the 1st example, when the effect of fluctuation of the voltage between terminals by transient phenomenon is small, steps S2 and S3 may be skipped. SOC and OCV do not need to convert into SOC and you may make it judge dispersion directly like a lithium system rechargeable battery in the fuel cell subsystem which becomes settled uniquely based on OCV.

[Translation done.]

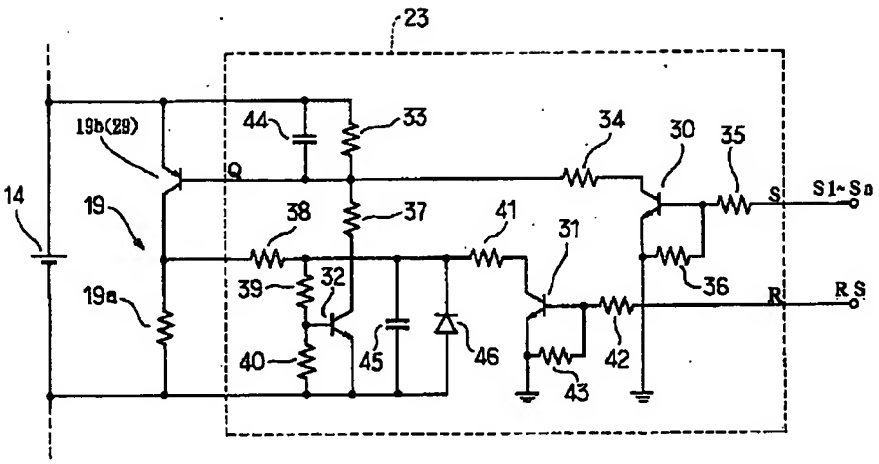
* NOTICES *

DRAWINGS

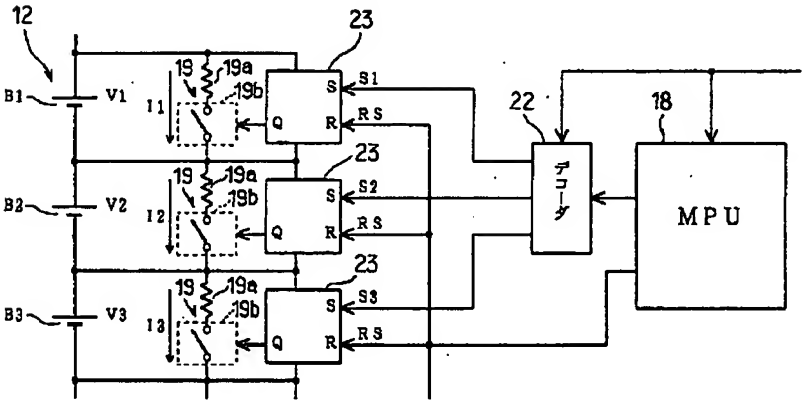
[Drawing 1]



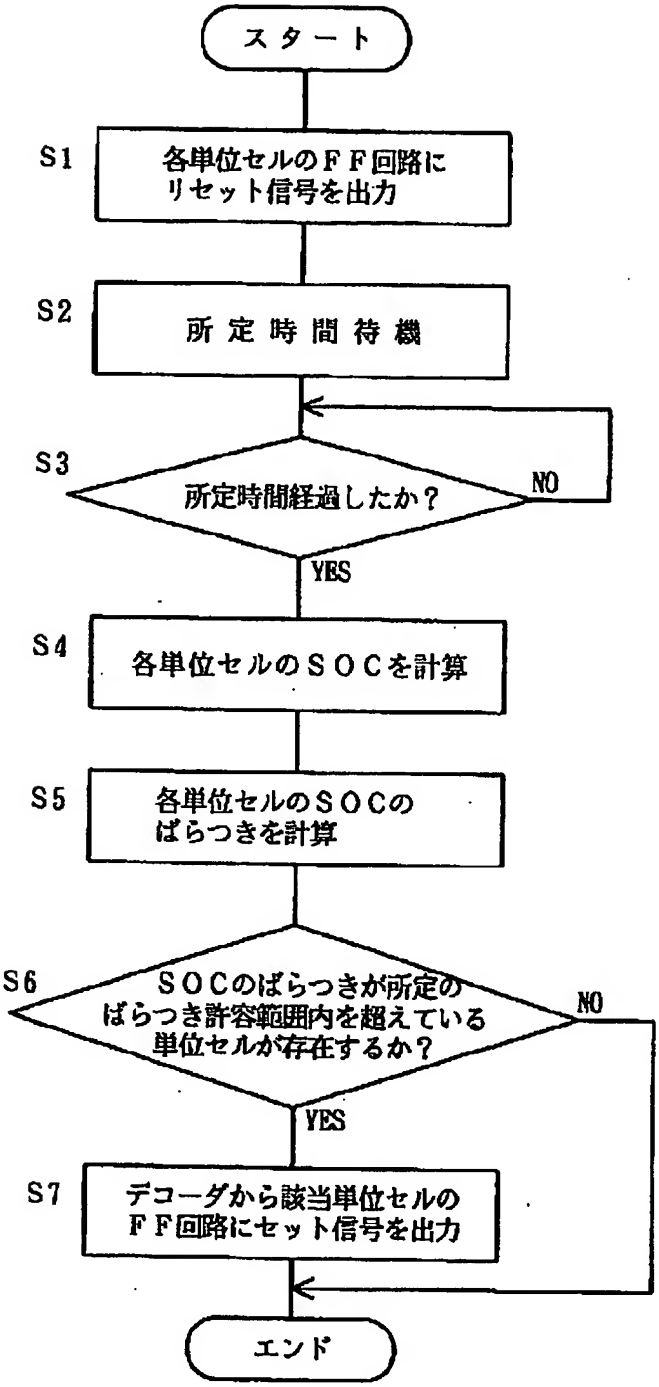
[Drawing 2]



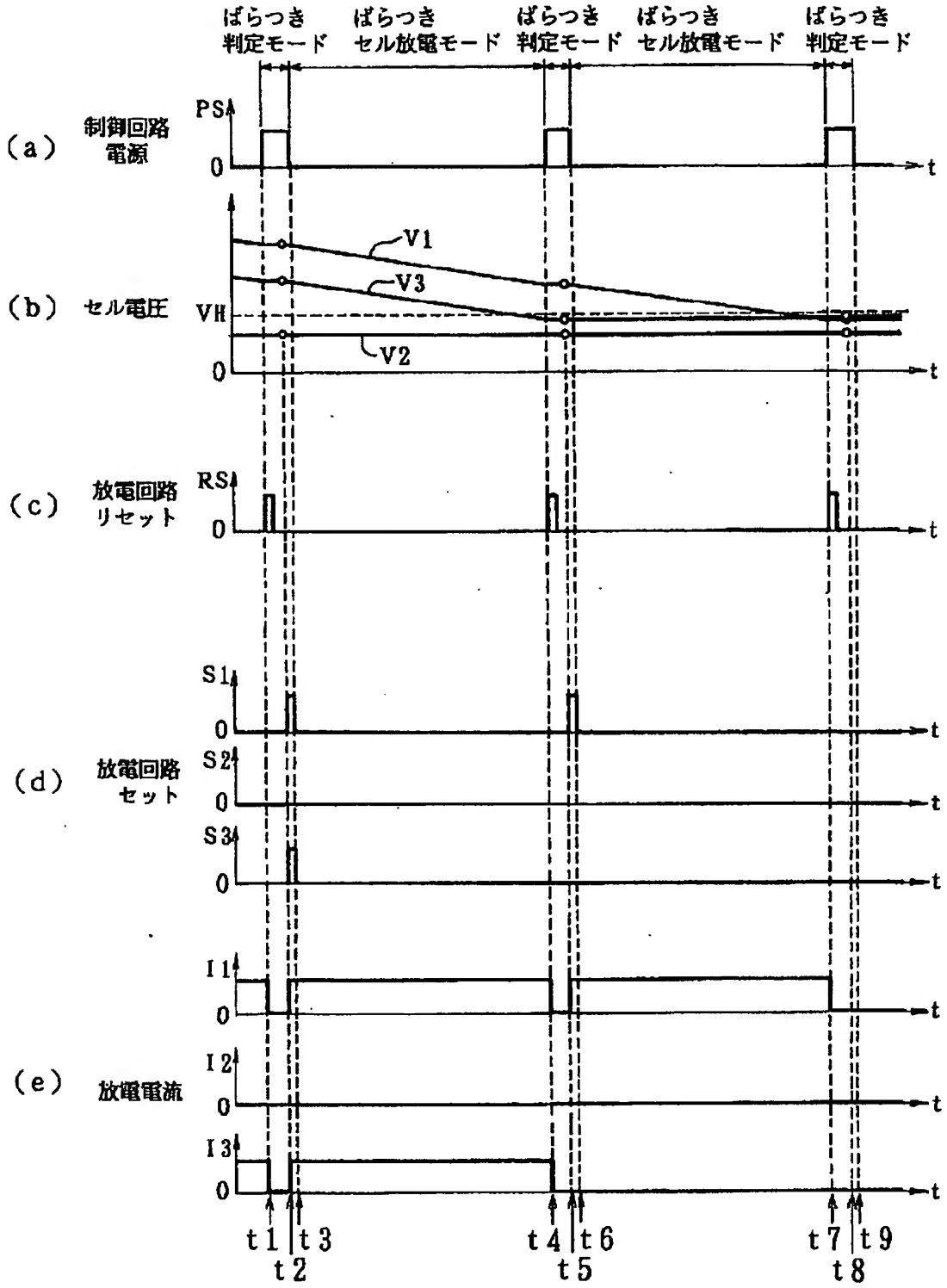
[Drawing 3]



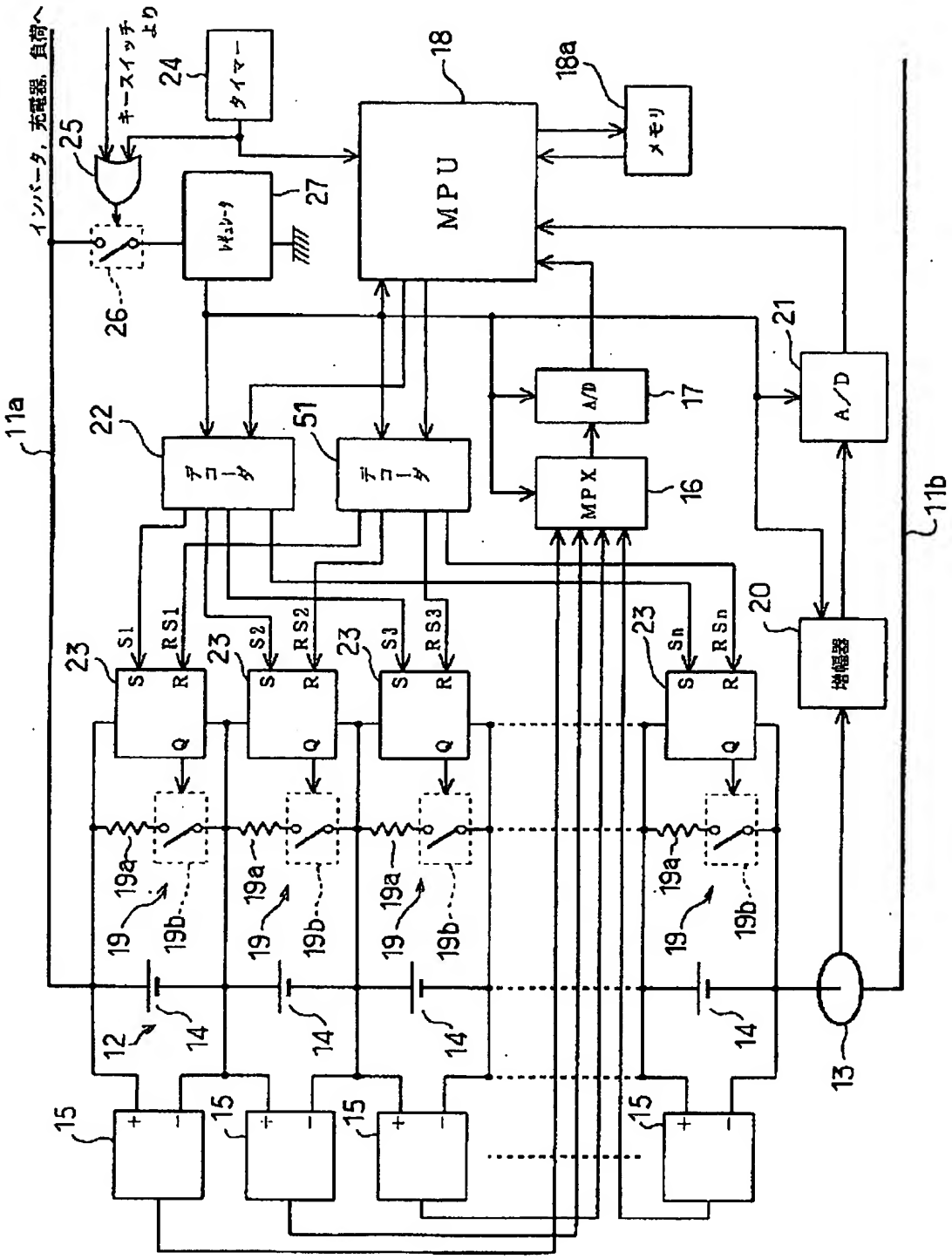
[Drawing 4]


スタート
S1
各単位セルのＦＦ回路に
リセット信号を出力
S2
所定時間待機
S3
所定時間経過したか？
NO
YES
S4
各単位セルのＳＯＣを計算
S5
各単位セルのＳＯＣの
ばらつきを計算
S6
ＳＯＣのばらつきが所定の
ばらつき許容範囲内を超えている
単位セルが存在するか？
NO
YES
S7
デコーダから該当単位セルの
ＦＦ回路にセット信号を出力
エンド

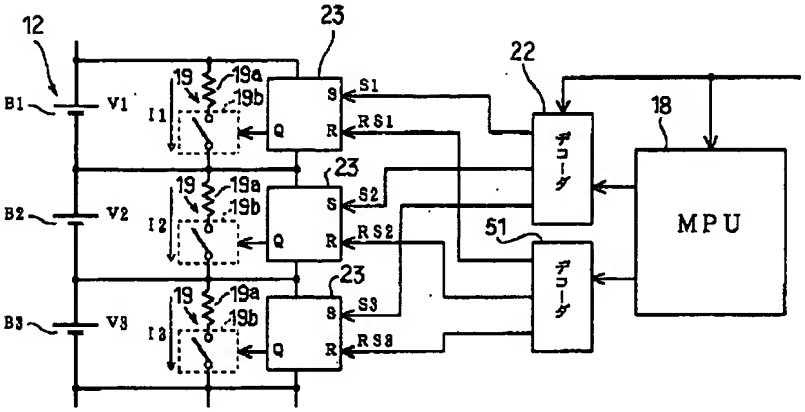
[Drawing 5]


ばらつき 判定モード
ばらつき セル放電モード
ばらつき 判定モード
ばらつき セル放電モード
ばらつき 判定モード
(a) 制御回路電源
PS
0
t
(b) セル電圧
V1
V3
VH
V2
0
t
(c) 放電回路リセット
RS
0
t
(d) 放電回路セット
S1
S2
S3
0
t
(e) 放電電流
I1
I2
I3
0
t
t1 t3 t2
t4 t6 t5
t7 t9 t8

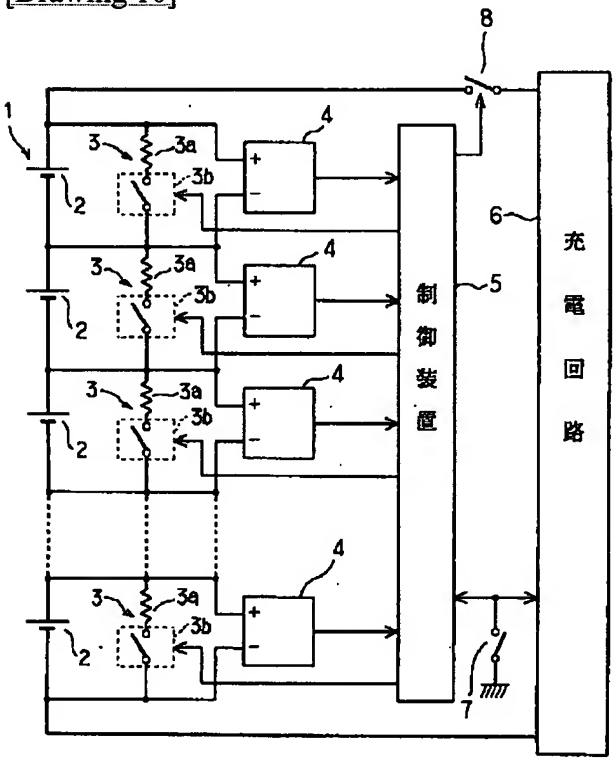
[Drawing 6]


インバータ，充電器，負荷へ
キースイッチより
タイマー
24
18
18a
メモリ
25
MPU
27
26
21
A/D
17
22
51
デコーダ
デコーダ
MPX
16
11a
11b
S1
RS1
S2
RS2
S3
RS3
Sn
RSn
20
増幅器
23
S
R
Q
19a
19b
19
12
14
15
13

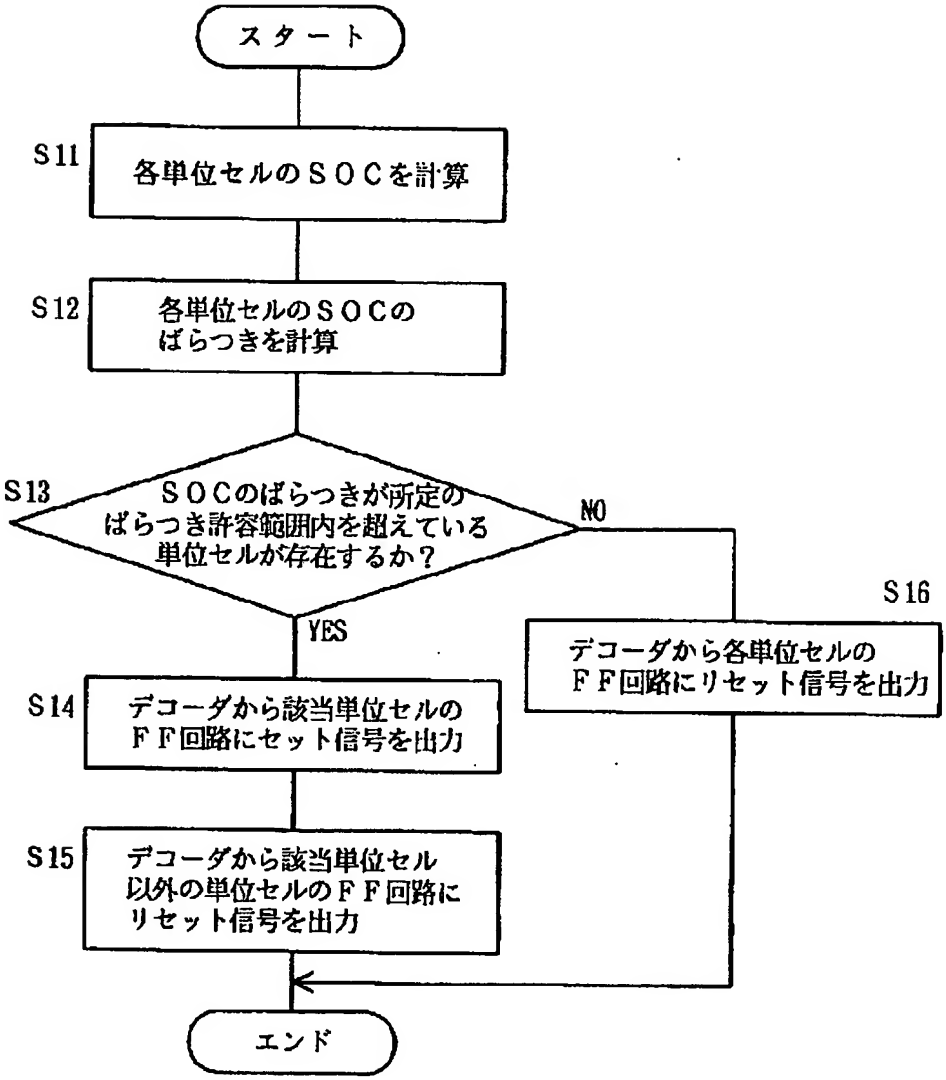
[Drawing 7]



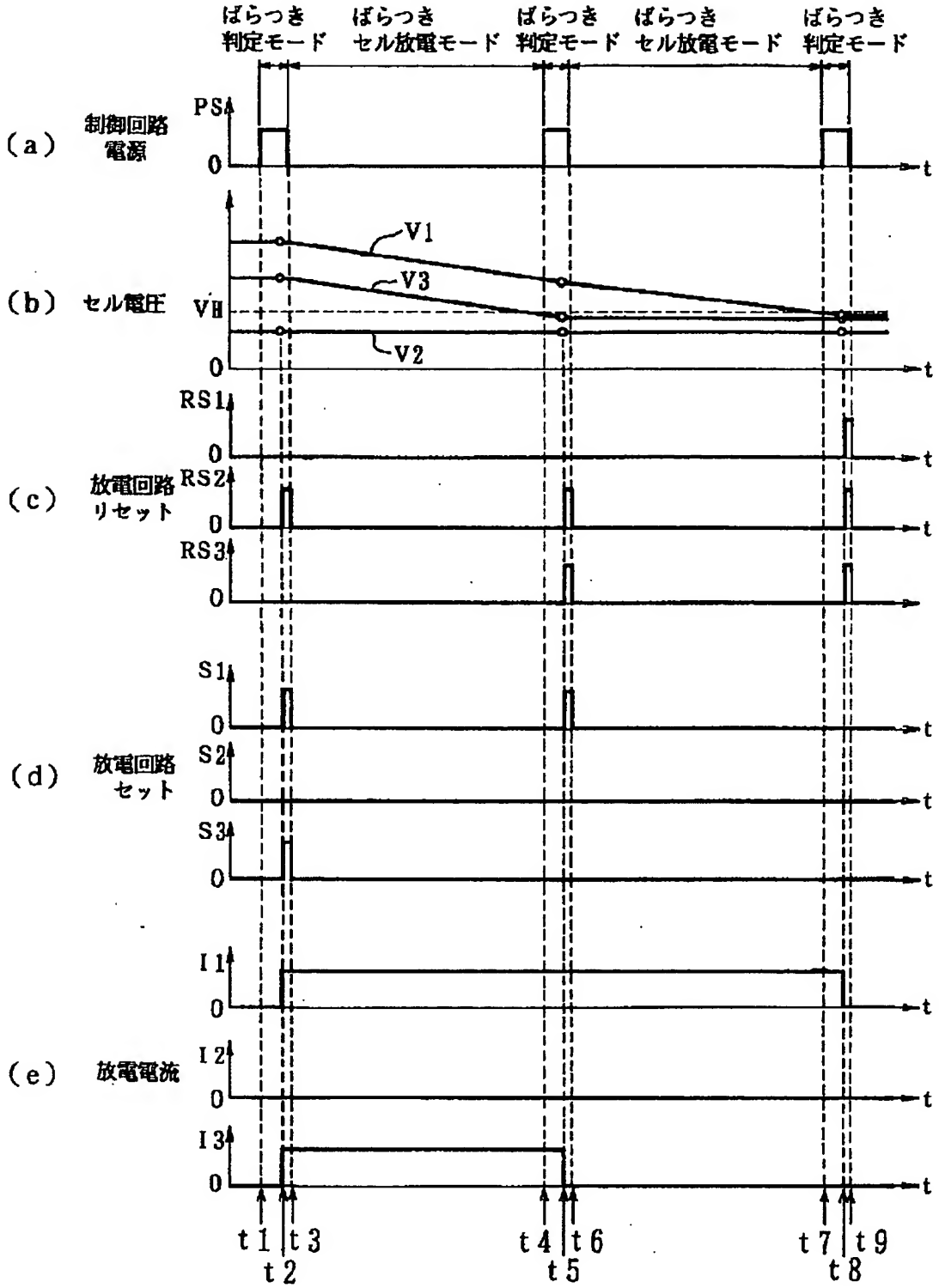
[Drawing 10]



[Drawing 8]


スタート
S11
各単位セルのＳＯＣを計算
S12
各単位セルのＳＯＣの
ばらつきを計算
S13
ＳＯＣのばらつきが所定の
ばらつき許容範囲内を超えている
単位セルが存在するか？
NO
YES
S16
デコーダから各単位セルの
ＦＦ回路にリセット信号を出力
S14
デコーダから該当単位セルの
ＦＦ回路にセット信号を出力
S15
デコーダから該当単位セル
以外の単位セルのＦＦ回路に
リセット信号を出力
エンド

[Drawing 9]



[Translation done.]